and suspended growth systems and eucaryotic and precaryotic cells.

4342 Sugar Processing Engineering (3) Prereq.: EE 22900, CE 2200 or CE 3309 or CHE 3217. Processes used in the manufacture of raw and refined sugar; application of engineering principles to unit operations of evaporation, crystallization, extraction, solids handling and drying, centrifugation, clarification, and steam and power systems; control of material flow systems, materials handling, utility systems, and materials of construction.

4352 Transport Phenomena in Biological Engineering (3) S Prereq.: CE 2352, BIOL 2031; credit or registration in CE 2200 and ME 3333. Mass balances with consideration of chemical and biological reaction kinetics; energy balance and principles of conduction, convection, and radiation including 3-D diffusion, transient heat transfer, and convection analysis; energy transfer in engineering design and analysis; principle of mass transfer.

4360 Mobile Fluid Power Control (3) Prereq.: ME 3384 or equivalent. 2 hrs. lecture; 3 hrs. lab. Theory and design of hydraulic and pneumatic control systems; power sources, hydrostatic transmissions, electrohydraulic servovalves, manual and automatic control applications.

4362 Agricultural Engineering (3) S Prereq.: 2 hrs. lecture; 3 hrs. lab. Principles and applications of geospatial technologies supporting precision agriculture/farming and planning for sustainable management systems.

4380 Aquacultural Engineering (3) F Prereq.: senior standing. Engineering principles applied to aquacultural systems; water treatment; fish, shellfish, and aquatic plant husbandry; fish pond design; recirculating aquacultural systems; water filtration; disinfection; aerating and deaerating systems.

4383 Natural Resource Engineering (3) F Prereq.: CE 2200. Engineering analysis and design of natural resource control systems; ground water systems; ponds, reservoirs; flood control, surface water quality, and wetlands.

4909 Introductory Topics in Biological Engineering (1-4) F,S,Su Prereq.: senior standing. Writing examined report required. May be taken for a max. of 6 sem. hrs. of credit when topics vary. Biological engineering practice: library research, experimental and/or theoretical investigation.

7304 Advanced Natural Resource Engineering (3) V Prereq.: BE 4383. Advanced topics in statistical hydrology, flow theory, evapotranspiration, transport of pollutants, drainage, irrigation, erosion, sediment transport, and sedimentation applied to rural fields and watersheds.

7306 Agricultural Systems Engineering (3) V Prereq.: BE 4290 or equivalent. Emphasis on agricultural systems engineering in problems in agriculture; queuing theory; modeling and simulation; linear programming; decision support systems, and animal and food systems; focus on current research topics in food engineering and food biotechnology.

7305 Advanced Instrumentation and Control for Food Engineering (3) V Prereq.: BIOL 2011 or 2012. Credit will not be given for this course and BIOL 2010. For nonscience majors. Not for degree credit for a student majoring in a biological science. General concepts in cell biology, genetics, ecology, and evolution.

7308 Advanced Topics in Biological Engineering (1-4) F,S,Su Prereq.: consent of instructor. May be taken for a max. of 6 hrs. of credit when topics vary. One or more of the following: 1. Microbiology; 2. Advanced biotechnology; 3. Advances in Neuroscience; 4. Advanced Topics in Cell Biology; 5. Advanced Topics in Molecular Biology; 6. Thesis Research (1-12 hrs. per sem.) "S" or "U" grading.

7500 Senior Design Project in Biological Engineering (1-2) V Prereq.: graduate standing in engineering. Only 1 sem. hr. of credit will be allowed toward the degree. Pass-fail grading.

7505 Advanced Topics in Biocatalysis (1) V Prereq.: F,S,Su Prereq.: consent of instructor. May be taken for a max. of 6 hrs. of credit when topics vary. One or more of the following: 1. Biocatalysis; 2. Biocatalysis; 3. Advanced Topics in Biocatalysis; 4. Advanced Topics in Biocatalysis; 5. Thesis Research (1-12 hrs. per sem.) "S" or "U" grading.

**BIOTECHNOLOGY SCIENCES**

General education courses are marked with stars (**).

**1001 General Biology (3)** F,S,Su Prereq.: Will not be given for this course and BIOL 2011. For nonscience majors. Not for degree credit for a student majoring in a biological science. General concepts in cell biology, genetics, ecology, and evolution.

**1002 General Biology (3)** F,S,Su Prereq.: BIOL 2011 or 2012. Credit will not be given for this course and BIOL 2010. For nonscience majors. Not for degree credit for a student majoring in a biological science. Diversity, interactions, and evolution.

**1005 Introductory Biological Laboratory (2)** F,S,Su Prereq.: credit in BIOL 1001 and credit or registration in BIOL 1002; 1 hr. lecture. Prereq. for students who have had BIOL 1207, 1208 or 1209. Basic principles of biology including cell biology, genetics, ecology, evolution, diversity, and exploration. (F,S,Su)

**1010 Microorganisms and Man (3)** Credit will not be given for both this course and BIOL 2051. Not open to biological science majors and nonscience majors interested in microbial topics. (F,S,Su)

**1201 Biology for Science Majors I (3)** Prereq. minimum ACT composite of 23 or "C" or better in CHEM 1201. Primarily for students in science, agriculture, or education. Credit will not be given for this course and BIOL 1005. General concepts in cellular structure, cellular metabolism, cellular communication, and genetics.

**1202 Biology for Science Majors II (3)** Prereq.: BIOL 1201. Primarily for students in science, agriculture, or education. Credit will not be given for this course and BIOL 1005. Focus on the mechanisms of development in vertebrates.

**2160 Human Physiology (3)** F,S,Su Prereq.: credit or registration in BIOL 1201, open to Biological Sciences, Biochemistry and Microbiology majors only. A one hour writing workshop outside class is required. Career opportunities in all fields of the biological sciences.

**2301 Science Teaching in Secondary School I: The Learner** Prereq.: registration in EDTC 3001 or equivalent and credit in either BIOL 2051 or 2151, or CHEM 1201, 2262, or 2461. 3 hrs. lecture; 3 hrs. lab. May be taken for a max. of 6 sem. hrs. of credit. Individual research as CHEM 3001 and PHYS 3001. Monitored and evaluated science tutoring experiences in a local middle school or high school under the guidance of the course instructor and a mentoring teacher.

**3002 Science Teaching in Secondary School II: Technology in Science Education** Prereq.: registration in EDTC 3002 or equivalent and credit in either BIOL 3001 and CHEM 3001, or CHEM 3001, or PHYS 3001. Also offered as EDUC 3002. Introduction to the integration of technology in demonstrations, and small and large group classroom activities, with a focus on inquiry-based approaches.

**3404 Evolution (3)** Prereq.: BIOL 2153. EXST 2201 recommended. Principles and processes in evolutionary biology. (F,S,Su)

**3404 Evolutionary Laboratory (1)** Prereq.: credit or concurrent enrollment in BIOL 3040. Lab to accompany lecture BIOL 3041. (F,S,Su)

**3600 Introductory Plant Physiology (4)** Prereq.: BIOL 1202 and CHEM 2060, 2261, or 2461. 3 hrs. lecture; 3 hrs. lab. Also offered as PLHL 3906. Life processes of plants emphasizing growth and development, metabolism, transport, and water relations.

**3900 Cell Biology (3)** Prereq.: BIOL 2153 and CHEM 2262. Molecular description of cell structure and function. (F)

**3916 Microbiology Laboratory (3)** F Prereq.: BIOL 2151, 2153, and 3900. 3 hrs. lecture; 3 hrs. lab. Credit will not be given for this course and BIOL 1201. Two-hour lecture and three-hour laboratory survey of marine animal groups and their relationships to the environment. (F)

**3925 Comparative Anatomy of the Vertebrates (4)** F Prereq.: BIOL 2153. BIOL 3090 recommended. 2 hrs. lecture; 6 hrs. lab. Macroevolution, biometrics and evolutionary biology applied to the comparative anatomy of selected vertebrates. (F)

**3966 Developmental Zoology (4)** Prereq.: BIOL 3090, and BIOL 4000. 3 hrs. lecture; 3 hrs. lab. Credit will not be given for this course and BIOL 4000. Focus on the development of vertebrates, including vertebrates, lab dissection of selected vertebrates. (F)

**3990 Undergraduate Seminar in Biological Sciences (1)** Prereq.: junior standing and consent of the instructor. Oral presentation of independent laboratory or library research on selected topics in biological sciences.

**3999 Undergraduate Research in Biological Sciences (1-3)** F,S,Su Prereq.: Permission of department. May be taken for a max. of 6 sem. hrs. of credit. Individual research problems in the biological sciences.

**4001 Physical Chemistry (3)** S Prereq.: CHEM 2262, PHYS 2151, and MATH 2252. Physical chemistry emphasis on solutions, equilibria, and topics of interest to students in biological sciences.

**4003 Insect Biology I** Prereq.: ENMT 4002. (F,S,Su)

**4003 Science Teaching in Secondary School III: Instructional Strategies in the Sciences (1)** Prereq.: credit in EDTC 2500 and BIOL 1201, 1202, and 4 hr. of additional biological sciences with laboratory. 2 hrs. lecture; 6 hrs. lab. Lifesaving skills; introduction to a science lesson using such a strategy; laboratory safety program management.

**4103 Seminar in Teaching Secondary: Methods in Teaching Science (3)** Prereq.: credit or registration in EDTC 4004 or equivalent, credit in registration in EDTC 4004, or equivalent and BIOL 4003, or CHEM 4003, or PHYS 4003. Also offered as CHEM 4004 and PHYS 4004.
4005 Science Research Methods (3) Prereq.: credit for EDCI 2500 and credit or registration in EDCI 3550. Also offered as 11 sem. hrs. of credit. permission of the department. Not for graduate credit. This course focuses on the tools that scientists use to solve scientific problems, including literature review, answering scientific questions, experimental design, use of statistics, and mathematical modeling of scientific phenomena. This course includes the oral presentation of work and a minimum of 10 hours of work in area middle and high schools.

4015 Conservation Biology (4) Prereq.: 11 sem. hrs. of credit recommended. See ENTM 4015. Laboratory. Not for graduate credit. This course will cover the role of the scientist in natural history and conservation biology. A minimum of 10 hours of work in area middle and high schools.

4016 Introduction to Insect Physiology (3) Prereq.: 12 hrs. of entomology or biological sciences; 1 yr. of organic chemistry and biology. 2 hrs. lecture; 5 hrs. lab. Also offered as ENT 4016.

4017 Laboratory in Conservation Biology (2) 3 hrs. lecture/1 hr. lab. BIOL/ENTM 4015 or equivalent. Same as ENT 4017. Laboratory to accompany BIOL/ENTM 4015. Practical application of principles of conservation biology, field study of major threats to an important area of biological diversity; human responsibilities as global stewards. Field study will be conducted as exercises to learn how to ask scientific questions, formulate a study, collect data, analyze data, and write scientific papers. Two all-day field trips on Saturdays.

4200 Taxonomy and Ecology of Wetland Plants (4) Prereq.: BIOL 2153, and 6 hrs. of credit. permission in area. 3 hrs. lecture; 3 hrs. lab; 3 hrs. extended field trips. Also offered as NRTN 4025. Field service fee. Taxonomy, ecology, distribution, and economic significance of plants in general are taught in class; field trips and laboratory exercises in various plant communities.

4204 Plant Anatomy (4) Prereq.: BIOL 1202 and 1209. 2 hrs. lecture; 4 hrs. lab. Principles of identification, classification, and nomenclature; their application to select groups of vascular plants and some non-vascular plants. 4 hrs. lab. Also offered as OCS 4025. Field service fee. Freshwater and marine algae, including morphology, biology, ecological role, and economic significance.

4253 Marine Biology (3) Prereq.: BIOL 1202 and 1209 or equivalent. 5 hrs. lecture. 4 hrs. lab. Same as AGRO/EMS 4025. Marine biology ecology of benthic, planktonic, nektonic, estuarine, ocean, coral, and mangrove communities; emphasis on Louisiana's coastal environments.

4254 Principles of Ecology Laboratory (1) F,S. BIOL 1202, 1209 and MATH 1552 or EST 2201. Fundamental ecological principles; laboratory exercises in the field and laboratory to test the inferences on how research in this area is performed; topics include physical, environmental, and physiological effects on behavior as well as possible evolutionary causes of present-day behaviors.

4299 Genetics of the Evolutionary Process (4) Prereq.: BIOL 2153 and consent of instructor. 1 hr. lecture; 6 hrs. lab. Principles of evolutionary change and speciation. The evolution of sympatric populations and the extremes of microevolution. Phylogenies and the origin and diversification of major groups of life. Multivariate analyses of morphological and molecular data. Modeling of biological systems; design and analysis of experiments to determine the genetic basis for evolution and its causes.

4301 Introductory Microbial Pathogens (3) Prereq.: BIOL 3090 or 4087 or 4093, and BIOL 4001 or credit in BIOL 4000 level. 1 hr. lecture; 6 hrs. lab. Biology of bacteria and archaea; evolution, diversity assessment, systematics, ecology; emphasis on molecular approaches to bacterial and archaeal sciences.

4302 Molecular Organization of Eukaryotic Microorganisms (3) F,S. BIOL 2153 and 6 hrs. of biological sciences at the 4000 level. 1 hr. lecture; 6 hrs. lab. Biology of fungi, algae, protozoa, and their interactions with other organisms. Introduction to microbial ecology. Laboratory exercises in basic and advanced physiology, as well as the isolation and characterization of microorganisms. Introduction to microbial genetics; plasmids and conjugation, transduction, and transformation; molecular biology techniques used to study microbial physiology.

4305 Comparative Animal Physiology (3) Prereq.: BIOL 3090 or 4087 or 4093. Physiological principles at the molecular, cellular, and organ systems levels are evaluated across many animal phyla. The ways in which diverse organisms perform similar functions are explained, revealing unifying principles of animal physiology. Course is partially illuminated with a comparative perspective.

4306 Biophysics of Macromolecules (3) Prereq.: BIOL 4002 or credit in BIOL 4000 level. 1 hr. lecture. Theory and application of physical
techniques to the study of biological macromolecules; spectroscopy (UV-VIS absorption and fluorescence, circular dichroism, NMR, IR, mass diffraction); helix-coil theory of ligand binding.

4600 Topics in Marine Zoology (2-6) Su Prereq.: 16 hrs. of biology or laboratory science courses numbered above 3000. Also offered as NROE 4600. May be taken for a maximum of 9 sem. hrs. of credit when topics vary. Courses to be offered various semesters in addition to the Marine Zoology Laboratory course available from department. Intensive field study of a special topic in marine zoology at the Louisiana Universities Marine Station, Cocodrie, La.

4653 Marine Physiology (4) Su Prereq.: 12 hrs. in biological science, including some plant biology. Four weeks at Gulf Coast Research Laboratory, Mississippi. Also offered as NROE 4653. May be taken for a maximum of 9 sem. hrs. of credit when topics vary. Specific areas of biological sciences; topics offered determined by recent advances in the field, needs of students, and availability of appropriate faculty.

7001 Tropical Ecology (3) Prereq.: BIOL 4253 or equivalent. Ecosystems and the biodiversities of tropical organisms, communities, and ecosystems, including plants, fungi, insects, reptiles, amphibians, birds, mammals, and fishes of tropical savannas, rainforests, and mangroves.

7010 Plant Molecular Biology (3) F Prereq.: BIOL 3060, 4093, and 4094 or equivalent. See PLH 7010.

7022 Marine Microbial Ecology (3) See OCS 7020.

7025 Advanced Plant Anatomy (3) Prereq.: BIOL 4024 or equivalent. Analysis of meristematic activity and growth patterns in vascular plants; basic mechanisms and differentiation and experimental studies of normal growth processes.

7043 Advanced Plant Taxonomy (4) Prereq.: BIOL 2153 or AGRI 2072, and BIOL 4041; or equivalent. 3 hrs. lecture; 3 hrs. lab. Fundamentals of natural variation and evolution; taxonomic features of plant families.

7044 Agrostology (3) Prereq.: BIOL 4041 or equivalent. 1 hr. lecture; 4 hrs. lab. Morphology, classification, identification, and economic importance of grasses and grasslike plants.

7061 Plant Growth and Development (3) See PLH 7061.

7063 Plant Metabolism (3) See PLH 7063.

7065 Transport Processes in Plants (3) Prereq.: BIOL 3060. Also offered as PLH 7065. Principles governing the transport of water, solutes, and nutrients in vascular plants, basis and mechanisms of differentiation and experimental studies of normal growth processes.

7067 Selection and Evolution (3) Prereq.: consent of instructor. May be repeated for a maximum of 6 sem. hrs. credit when topics vary. May be offered for a maximum of 9 sem. hrs. of credit. Directed individual readings under the guidance of a graduate faculty member.

7090 Independent Research in Biological Sciences (2-8) Prereq. of instructor. May be repeated for a max. of 9 sem. hrs. credit. Directed individual research under the guidance of a graduate faculty member.

7995 Independent Readings in Biological Sciences (1-3) Prereq. of instructor. May be taken for a max. of 9 sem. hrs. of credit. Directed individual readings under the guidance of a graduate faculty member.